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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 48881	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. <b>PCT/AU99/00448</b>	International filing date ( <i>day/month/year</i> ) 9 June 1999	Priority Date ( <i>day/month/year</i> ) 11 June 1998
International Patent Classification (IPC) or national classification and IPC  <b>Int. Cl. <sup>7</sup> B29C 33/04, 45/73, 45/74, 51/42, B21C 29/04, B22C 9/00, F01P 3/22</b>		
Applicant <b>JAMES, Malcolm Barry</b>		

1.	This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2.	This REPORT consists of a total of 4 sheets, including this cover sheet.  <input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  These annexes consist of a total of 14 sheet(s).
3.	This report contains indications relating to the following items:  I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 1 December 1999	Date of completion of the report 20 July 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>M.R. OLLEY</b>  Telephone No. (02) 6283 2143

**I. Basis of the report****1. With regard to the elements of the international application:\***

- ☐ the international application as originally filed.
- ☒ the description,      pages      , as originally filed,  
pages      , filed with the demand,  
pages 1-11, received on 2 May 2000 with the letter of 2 May 2000
- ☒ the claims,      pages      , as originally filed,  
pages      , as amended (together with any statement) under Article 19,  
pages      , filed with the demand,  
pages 12-14, received on 18 July 2000 with the letter of 22 June 2000
- ☒ the drawings,      pages 1-6, as originally filed,  
pages      , filed with the demand,  
pages      , received on      with the letter of
- ☐ the sequence listing part of the description:  
pages      , as originally filed  
pages      , filed with the demand  
pages      , received on      with the letter of

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, was on the basis of the sequence listing:**

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

**4. ☐ The amendments have resulted in the cancellation of:**

- ☐ the description,      pages
- ☐ the claims,      Nos.
- ☐ the drawings,      sheets/fig.

**5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

**Continuation of Box 1**

New claim 15 is considered to go beyond the disclosure as originally filed. In the original specification there was no disclosure of partially filling of the closed chamber and then extracting air. Consequently this opinion has been established as if this claim had not been filed.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 1-17	YES
	Claims	NO
Inventive step (IS)	Claims 1-17	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-17	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)**

US 4488861 (REIFENHAUSER)

CA 1251612 (AEC)

DE4033677 (METZELER GIMETALL)

FR 2339427 (BRUNSWICK)

Derwent Abstract Accession No. 91-020636/03, Class A31, SU 1565709 (TAMBOVSK POLYMER) 23 May 1990

US 2292946 (KARIG)

None of the above documents disclose all of the features of the invention claimed, therefore the claims are novel and have an inventive step.

From the:  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:  
  
COLLISON & CO  
GPO Box 2556  
ADELAIDE SA 5001

COLLISON & CO.

27 JUL 2000

REF. ....

**PCT**  
NOTIFICATION OF TRANSMITTAL OF  
INTERNATIONAL PRELIMINARY EXAMINATION  
REPORT

(PCT Rule 71.1)

Date of mailing  
day/month/year

**25 JUL 2000**

Applicant's or agent's file reference

48881 PCT

**IMPORTANT NOTIFICATION**

International application No.  
**PCT/AU99/00448**

International filing date  
9 June 1999

Priority date  
11 June 1998

Applicant

**JAMES, Malcolm Barry**

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translations to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide

Name and mailing address of the IPEA/AU

AUSTRALIAN PATENT OFFICE  
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**PATENT COOPERATION TREATY**  
**PCT**  
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Name and mailing address of the IPEA/AU <b>AUSTRALIAN PATENT OFFICE</b> <b>PO BOX 200, WODEN ACT 2606, AUSTRALIA</b> E-mail address: <b>pct@ipaaustralia.gov.au</b> Facsimile No. <b>(02) 6285 3929</b>	Authorized Officer  <b>M.R. OLLEY</b>  Telephone No. <b>(02) 6283 2143</b>

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09/719136

533 Rec'd PCT/PTO 07 DEC 2000

1

## TEMPERATURE CONTROL METHOD AND APPARATUS

5 This invention relates to a temperature control method and apparatus applicable to machines and has particular application to dies and to moulding of articles using dies in processes such as injection moulding, thermoforming, vacuum forming metal die casting and the like.

10 The invention will be described with respect to an application but it is not intended that the concept should be constrained simply to that application.

15 It is well known that a die can be kept within an acceptable temperature range by use of water passing through passages in the die to a separate heat exchange station.

20 One of the challenges in the design of dies is to ensure that the working parts of the die have sufficient access to cooling water. This can at times be very difficult indeed if, for instance, there is very little room for appropriate passages for water to be transported to and from a location in sufficient volume.

25 Such a challenge of keeping the working parts of a die within an acceptable range of temperatures is no small matter and can involve considerable costs in the manufacturing and commissioning of a die. One of the problems experienced is that unless the water is demineralised which is generally uneconomic because of the volume of replacement water needed, then scale build up will occur which again can be costly to treat and can lead to reduced efficiency in cooling over time.

30 A further problem is the corrosion in the cooling passages caused by their exposure to aerated cooling water.

35 Further the efficiency of cooling can be a very significant factor in the repetition rate of use of a die. If there were a more efficient way of cooling the die may be able to be used at greater repetition rates which is significant as far as costs of production using the die are concerned.

Further uneven cooling rates between different portions of a moulding die can cause distortion of the moulded parts for which rectification or compensation can be costly.

It is an object of this invention to propose an alternative way to effect temperature control of a machine which at least reduces some of the above difficulties.

- 5 In one form of this invention this can be said to reside in a mould of a type requiring heat to be taken from the mould from time to time, characterised in that the mould includes at least one closed chamber having liquid therein which extends to cover at least one of the areas from which heat is to be taken, and a space above the liquid and within the closed chamber, wherein pressure is set at a level which will enable  
10 the liquid to boil at a selected temperature and condensing means to effect, by cooling, condensation of vapour of the liquid in the space.

In preference there are more than one chamber and each chamber is shaped and positioned together with the level of liquid therein so that the liquid will access during  
15 washing conditions areas in the machine from which heat is to be taken.

In preference the liquid is water.

In preference the mould is a machine for moulding of plastics materials.  
20

In preference the mould is a mould for injection moulding of plastics materials.

In preference the mould is a mould for moulding by thermoforming of plastics materials.  
25

In preference the mould is a mould for the die casting of metals.

In a further preferred form of this invention this can be said to reside in a mould having an internal cooling arrangement which includes a closed chamber having  
30 therein a liquid with a volume such that it has an upper level above one of the areas of the mould to be cooled and substantially only the vapour of the liquid within the chamber above the upper level of the liquid.

In a further preferred form of this invention this can be said to reside in a mould for  
35 injection moulding of plastics materials having an internal cooling arrangement which is a closed chamber partially filled with a liquid with an upper level sufficient that areas of the die within the chamber adjacent to parts of the die to be cooled will be

accessed by the liquid and, in the space in the chamber above the liquid, substantially only the vapour of the liquid.

5 In a further preferred form of this invention this can be said to reside in a mould for injection moulding of plastics materials having an internal cooling arrangement which is a closed chamber partially filled with a liquid with an upper level of sufficient height so that one of the areas of the mould within the chamber adjacent to parts of the mould to be cooled is covered by the liquid and, in the space in the chamber above the liquid, substantially only the vapour of the liquid, and an arrangement to  
10 provide cooling of any vapour within the space in the chamber above the liquid level to effect at least some condensation of the vapour thereby.

In preference there is at least in addition, a heating means located within the chamber within the liquid such that during a standby time, the temperature of the  
15 mould can be kept within a selected range of temperatures.

In preference the cooling means include a tube, a core in the tube and means to direct cooling water through the tube.

20 In a further preferred form of this invention this can be said to reside in a method of cooling of parts of a mould where the mould has at least one closed chamber having liquid therein which extends to cover at least one of the areas from which heat is to be taken, and a space above the liquid and within the closed chamber in which the pressure is caused to be at a level at which the temperature of the boiling  
25 point of the liquid will be to at least a selected extent below the temperature of the area from which heat is to be taken and there are condensing means to effect, by cooling, condensation of vapour of the liquid in the space.

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35 area from which heat is to be taken this being by reason of, as a first step, filling of the closed chamber with the liquid and then extracting a sufficient proportion of the liquid without allowing air to replace the extracted liquid, and passing at a selected

cooling temperature, liquid through condensing means to effect, by such cooling, condensation of vapour of the liquid in the space.

5 In use then condensation of the vapour may be effected by providing a heat exchange either by an independent member within the space above the liquid level or by having a portion or all of the wall defining the chamber in an area above the liquid surface which is at a lesser temperature but in any event, so that there will be a reasonably effective exchange of heat from the vapour of the liquid so that this then condenses back into liquid and will flow back into the body of the liquid  
10 within the closed chamber.

The portion of the chamber to receive heat will, by reason of a raised temperature of the immediately adjacent liquid to a level of that of liquid in adjacent areas, effect an exchange of state of the liquid in this area to vapour which by reason of the  
15 latent heat capacity of the vapour will be a very substantial carrier of heat. By reason of relative densities then, the vapour thus formed will rise to the surface of the liquid, continuing to fill the space above the liquid where continuing condensation is being effected by a reverse exchange of heat.

20 The boiling of the liquid occurs in a very vigorous manner because at very low pressures the volume of vapour produced is very high compared with the volume of liquid being vapourised. This raises the effective level of the liquid relative to a rest state, enabling it to affect areas of the mould that are above its rest level.

25 What we have then is a closed chamber with its selected liquid operating so that it is at a temperature and pressure governed by its own vapour pressure and by external inputs of heat.

A number of variations can be incorporated within the general concept.  
30

In a first method, the internal chamber is filled entirely with the liquid to be used. In preference, such liquid is previously treated so as to remove dissolved gases and other impurities so that in preference, the liquid is a liquid without impurities which may otherwise interfere with the process or the efficiency in general of the process.  
35

Once full and sealed, the chamber is then accessed through a gate valve so that some of the liquid is then extracted with a pump to a level that is chosen such that the level will be below a condensation member or means within the upper part of

the chamber, and that there will be liquid in contact with a heat source which is to provide the heat to be dissipated.

5 In a further preferred method the chamber can be partially filled to a required level and the residual air can be removed to a sufficient extent by a conventional vacuum pump capable of achieving residual pressures of less than 13 milibars.

10 Following these steps, the mould is then ready to be used where there is a heat exchanger in an upper part of the internal chamber to provide heat exchange where a further liquid is pumped through the heat exchanger at a preferred mould operating temperature but in preference not a low enough temperature to cause freezing of the liquid.

15 It is expected at this stage that the liquid would normally be water but it is understood that there are many liquids other than water that would provide a good effect.

20 For each individual circumstance, the degree of heat to be shifted, the extent of the hot surfaces to be cooled, and the general temperature that has to be worked on, need to be considered to take into account the overall shape and dimensions of the chamber, the fluid to be used, the degree of vapour space above the liquid level, and the condensing means within the vapour space.

25 In experiments so far conducted, such an arrangement provides very effective and relatively uniform heat transfer. While reference has been made to a chamber, this does not of itself exclude the case where there can be separate chambers connected by sealed conduits.

30 A chamber then is to be considered as a concept broad enough to encompass any closed environment.

For a further explanation of the invention this will be described with reference to a further embodiment which shall be described with reference to an accompanying drawing wherein:

35 FIG. 1 is a schematic cross sectional view of a thermoforming apparatus in accordance with a first embodiment;

FIG. 2 is a cross sectional view of the male side of a plastic injection die;

FIG. 3 is a cross sectional view along the lines 3-3 in FIG. 2 of the second

embodiment;

FIG. 4 is an exploded perspective view of the plastic injection die, the male side of which is shown in FIGS. 2 and 3;

FIG. 5 is an exploded perspective view of the parts forming the portion of  
5 the second embodiment as shown in FIGS. 2 and 3; and

FIG. 6 is a section along the lines 6-6 in FIG.3.

Referring in detail to Figure 1 there is shown a thermoforming apparatus 1 with a plug 2 arranged to push plastic sheet into a shaping cavity 3. The sheet 4 is  
10 subject to conventional treatment including having air at pressure drive the formed sheet 4 into close conforming shape of the cavity 3.

The cavity 3 is surrounded by a hollow body 5 which defines a closed chamber together with conduits 6 and 7 and condensing container 8. Within the condensing  
15 container 8 is a heat exchange coil 9 which is supplied with appropriate cooling refrigerant.

Conduit 7 passes beneath plastic sheet holding means 13 and therefore could cause a liquid blockage to passage of vapour through to the condensing container  
20 8.

This effect can be removed by introducing additional heat through heating coil 11 which will effect a vaporisation of the liquid at this location.

Initial startup of this apparatus is achieved by filling the chamber which includes the  
25 hollow body 5, the conduits 6 and 7 and the container 8 with water. Through the valve 12 water is then extracted until its level is lowered to a level as shown at 15. This then leaves an upper evacuated space 16 which will then be filled implicitly by substantially only the vapour of the liquid.

30 From here on the arrangement will remain as a closed system so that heat from the wall of the cavity 3 will be converted into latent heat of vaporisation with the vapour reaching the condensing chamber 8 to be returned to liquid. as it gives up the latent heat of vaporisation to the heat exchange coil 9.

35 Now referring to FIGS. 2 through to 5, there is shown specifically in FIGS. 2, 3 and 5 the male side of an injection die and for ease of description, reference will be

made to these parts and then later to the female side of the die as more generally shown in FIG. 4.

Accordingly, the male form 17 is attached through appropriate bolts which are  
5 located at position such as at 18 to a block 19 which together with a backplate 20 forms a closed chamber 21 of similar shape to form 17 which holds a selected quantity of water shown generally at 22. Male form 17 and block 18 may be formed as a single piece.

10 The water 22 does not totally fill the enclosed and closed space 21 thereby leaving a space 23 above an upper level of the water 24.

There is a heat exchanging cooling device at 25 which is arranged by reason of tube 26 which has a plurality of fins 27 to effect a cooling of water vapour as it  
15 exists within the space 23.

The temperature of the fins 27 is governed by arranging for flow of cooling water through an inlet 28 which then proceeds through the centre of a removable core 29 to an end 30 where the water then is caused to pass through a spirally shaped gap  
20 31 so that it will pass fully the length of the hollow core 29 to then exit through passageway 32.

An advantage of this arrangement is that the hollow core 29 is held by plug 33 so that from time to time, the core can be easily removed without affecting the status of  
25 the evacuated space 23 and any build up of deposits, debris or otherwise can be then effectively cleaned.

A gate valve 34 is adapted to effect a closure of aperture 35 and evacuation port  
30 44 and there is a further closable plug at 36.

In order to charge the die, water is first vigorously boiled for at least one minute so as to reduce possible dissolved gas from the water.

The water is then poured into the chamber 21 through aperture 36 so that it will fully  
35 fill the chamber. The gate valve 34 includes a pair of sealing members 45 thereon which act so that when open, water can be extracted from the chamber through evacuation port 44 while maintaining the closure of aperture 35 and when closed, to prevent air from flowing into the chamber through the evacuation port 44.



The amount of water removed is such as to provide a sufficient space above the selected water level to allow for the cooling device to operate within the environment generally only of the water vapour and not the liquid water.

5

With the then degassed water partially filling the closed chamber 21, it will be seen that the water then covers or can access during operation those parts of the die as shown, for instance, in FIG. 1 or FIG. 2 which are immediately adjacent those areas that will be in contact with heated plastics materials and from which heat is to be

10

extracted.

By reducing the pressure within the closed chamber 21, the water adjacent to the hotter parts of the die will be caused to boil at temperatures somewhat lower than 100 degrees Centigrade (212 degrees Fahrenheit) and because of the high value of the latent heat of evaporation of water such effect results in very efficient extraction of heat from the hotter parts of the die.

15

By reason of the orientation of the die, and by reason of shaping of the internal parts of the die so that vapour when formed can rise into the uppermost space within the closed chamber 21, this then will further concentrate water vapour in the space which in turn will be cooled and therefore be condensed by heat exchange from the heat exchanger system.

20

While different methods of preparing the status of liquid within the closed chamber 21 can be used, and there has been described in a general way, such an arrangement, in a further method, there is firstly provided a funnel with a spout threaded to fit the inlet or filling port to a capacity greater than the volume of water to be removed from the filled enclosed chamber 21.

25

A reciprocating vacuum pump with a single stroke capacity equal to the volume of water to be removed is attached to an evacuation port.

30

Once the water has filled the chamber, the vacuum pump can be used so as to withdraw and then return a number of times so as to cause water within the system to surge back and forth so as to assist in removal of any significant air bubbles which may have been trapped while filling.

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The chamber is then again topped up with water on the basis that some air has been dislodged and driven to the surface of the water and the inlet or filling port is then closed.

- 5     The vacuum pump can again be caused to withdraw and return a number of times so as to cause water in the system to surge back and forth. With each withdrawal, the pressure inside the chamber will be considerably reduced and any remaining trapped bubbles of gas will expand and most will rise to the surface of the water.
- 10    The vacuum pump stroke is then returned and the chamber is again topped up with water and the inlet port is closed.

With a full stroke of the vacuum pump the required amount of water will be extracted and the gate valve 34 is then screwed in to close the evacuation port 44.

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In this process, it is provided that the gate valve 34 allows the water to gravitate easily into the pump. Since air is excluded substantially, gravity is needed to move the liquid into the vacuum pump.

- 20    This describes, as has been previously stated, one side of an injection die where the further portion of the injection die is shown in exploded detail in FIG. 4. In this case then, there is a closed chamber 37 which surrounds a female shape 38 into which the male part 17 is located to form there between a moulding space served by inlet port 39.

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A back plate 40 has sealed engagement with the die 41 and there are shown heat exchange means at 42 with a hollow removable core 43.

- 30    The filling procedure of this side of the die is the same as with the first male portion of the die.

- 35    One of the advantages of the arrangement described is that the temperature of the die is automatically evened out because boiling will occur preferentially at the higher temperature locations thereby reducing its temperature to that of its surrounding areas.

4. The output of the blow torches was adjusted until a temperature rise of 2.7 degrees Centigrade in the coolant was achieved. This corresponded to a heat extraction rate of 750 watts.
5. The temperature of the die was found under these conditions to reach and  
5 be sustained at 48 degrees Centigrade which is to say 21 degrees Centigrade above the coolant temperature.
6. The temperature of water in the enclosed chamber was stabilised and was 35 degrees Centigrade.
- 10 Direct calculation of an expected temperature of the core, based on its geometry and the test conditions, were also made. The calculated temperature differential through the walls of the core is 12 degrees Centigrade and this was found to correspond very well with the experimental result. The remainder of the temperature differential (8 degrees Centigrade) is a function of the efficiency of the  
15 heat exchanger.

It is considered from the above experimental results that these illustrate a very outstanding effective result which will be of very significant value in many applications where moulds are to be cooled and where achieving a uniformity of  
20 the cooling effect is of value.

Further, because the closed chamber keeps the same water through the full cooling process, it is not expected that there will be mineral deposit or any significant corrosion (as a result of the absence of air).

25 While in preference only water is used, other liquids or mixtures of liquids can be used and, in such a case, it is substantially only the vapours of the liquids that will exist only in the space above the level of the liquid in the closed chamber.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A mould of a type requiring heat to be taken from the mould from time to time, characterised in that the mould includes at least one closed chamber having liquid therein which extends to cover at least one of the areas from which heat is to be taken, and a space above the liquid and within the closed chamber, wherein pressure is set at a level which will enable the liquid to boil at a selected temperature, and condensing means to effect, by cooling, condensation of the vapour or vapours of the liquid in the space.
2. A mould as in claim 1 further characterised in that the chamber is shaped and positioned so that the liquid therein will have effective access to each of the areas of the mould from which heat is to be taken.
3. A mould as in either of claims 1 or 2 further characterised in that the liquid is water only.
4. A mould as in either of claims 1 or 2 further characterised in that the mould is a mould for moulding of plastics materials.
5. A mould as in either of claims 1 or 2 further characterised in that the mould is a die for the mould casting of metals.
6. A mould as in either of claims 1 or 2 further characterised in that the mould is a mould for injection moulding of plastics materials.
7. A mould as in either of claims 1 or 2 further characterised in that the mould is a mould for moulding by thermoforming of plastics materials.
8. A mould having an internal cooling arrangement which is a closed chamber having therein a liquid with a volume such that it has an upper level above at least some of the areas of the mould to be cooled and has substantially only the vapour or vapours of the liquid in a space within the chamber above the upper level of the liquid and condensing means to effect, by cooling, condensation of the vapour or vapours of the liquid.
9. A mould for injection moulding of plastics materials having an internal cooling arrangement which is a closed chamber partially filled with a liquid with an upper

level sufficient that at least some areas of the mould within the chamber adjacent to parts of the mould to be cooled are accessed by the liquid when the mould is in use and, in the space in the chamber above the liquid, substantially only the vapour of the liquid and condensing means within this space.

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10. A mould for injection moulding of plastics materials having an internal cooling arrangement which is a closed chamber partially filled with a liquid with an upper level of sufficient height so that at least some areas of the mould within the chamber adjacent parts of the mould to be cooled are accessed by the liquid when the  
10 mould is in use and, in a space in the chamber above the liquid, substantially only the vapour of the liquid, and an arrangement to provide cooling of any vapour within the space in the chamber above the liquid level to effect at least some condensation of the vapour thereby.

- 15 11. A mould as in any one of the preceding claims where the liquid is water.

12. A mould as in any one of preceding claims further characterised in that the vapour is water vapour.

- 20 13. A mould as in any one of the preceding claims 9-12 further characterised in that there is at least a heating means located within the chamber within the liquid such that during a standby time, the temperature of the die or mould can be kept within a selected range of temperatures.

- 25 14. A mould as in any one of the preceding claims 9-12 further characterised in that the cooling means include a tube, a core in the tube and means to direct cooling water through the tube.

15. A method of cooling of working parts of a mould where the mould has at  
30 least one closed chamber having liquid therein which extends to cover at least one of the areas from which heat is to be taken, and a space above the liquid and within the closed chamber in which pressure within the space is caused to be set at a level which will enable the liquid to boil at a selected temperature, said selected temperature being at a level such that the temperature is below a temperature of  
35 the area from which heat is to be taken this being by reason of, as a first step, partially filling of the closed chamber with the liquid and then extracting air so that there is substantially only the vapour or vapours of the liquid within the chamber above the upper level of the liquid, and passing at a selected cooling temperature.

liquid through condensing means to effect, by such cooling, condensation of vapour of the liquid in the space.

- 5 16. A method of cooling of working parts of a mould where the mould has at least one closed chamber having liquid therein which extends to cover at least one of the areas from which heat is to be taken, and a space above the liquid and within the closed chamber in which pressure within the space is caused to be set at a level which will enable the liquid to boil at a selected temperature, said selected temperature being at a level such that the temperature is below a temperature of  
10 the area from which heat is to be taken this being by reason of, as a first step, filling of the closed chamber with the liquid and then extracting a selected proportion of the liquid without allowing air to replace the extracted liquid, and passing at a selected cooling temperature, liquid through condensing means to effect, by such cooling, condensation of vapour of the liquid in the space.

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17. A method as in any one of the preceding claims further characterised in that the liquid is water.

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